FILE COPY FOREST INSECT LABORATORY, STANFORD UNIVERSITY CALIFORNIA.

540.ab
520.e6
Speeches M.S.
11/20/25

UNITED STATES DEPARTMENT OF AGRICULTURE,

Bureau of Entomology.

Forest Entomology.

Pacific Slope Laboratory,
Stanford University, Cal.
November 20, 1925

INSECTS AFFECTING FOREST RECREATIONAL AREAS IN SOUTHERN CALIFORNIA

By
J. M. Miller and H.L. Person

Introduction

The development of recreational areas in the mountains of Southern California has brought about an unusual emphasis on the preservation of the existing forest cover. The forests of this region are so limited in extent that they are hardly adequate to meet the growing demand of the present population for summer homesites and playgrounds. In recent years, millions of dollars have been invested in recreational development in the San Bernadino Mountains alone. Both public and private owners of large acreages have opened and developed tracts designed to make the recreational features of these areas available to a large number of people. The future value of these investments will depend largely on the maintenance of the present forests, as without this cover, these more favored sites would be little if any more attractive than the surrounding brush and barren areas.

Conditions.

The forest type and site conditions of this region are such that more or less damage from insect attacks is to be expected. Conifers, including western yellow pine, coulter pine, jeffrey pine, sugar pine, white fir and some big cone spruce, compose the principal part of the forest cover. Oaks figure to a considerable extent in the understory. The forest cover is considerably broken with abrupt changes from one type to another due both to varying conditions of soil and slope and the effects of old logging operations and fires.

Character of Losses.

Insect losses in standing timber are principally due either to the defoliators, which feed upon the foliage of the tree, or the cambium miners, principally bark beetles and flatheaded borers, which feed upon the tissue between the bark and wood.

Defoliators, although of great importance in some sections of the country, may be disregarded in the section under consideration. Foliage destroying insects occasionally work in this area, notably on the alder, but their work to date has been sporadic in nature and seldom fatal to the trees.

The unhealthy condition of many of the oaks is not due to insects but to mistletoe and woodrotting fungi.

The bark beetles together with the less important flatheaded borers cause the principal loss and it is their control that constitutes our main problem.

It is the usual habit of the tree killing species of this group to concentrate their attacks in certain trees which they kill by mining out the cambium or sap conducting tissues of the tree. Because of this habit of concentration, the entire forest never becomes infested in any one season. A low percent of the trees are killed outright each season while the remainder of the stand continues its normal growth.

Among the old mature trees the annual killing consists of isolated trees here and there with occasional groups of from three to ten. In the second growth the damage takes on the character of sporadic killing of fairly large groups of from 50 to 100 trees.

Seasonal increases in the numbers of insects and consequent losses of timber often come on with unexpected suddenness. These increases which are known as epidemics, usually last only a few years, but they seldom subside without making a very appreciable reduction in the number of living trees in the affected territory. It is apparently true that on many of the Southern California areas the old veteran trees, which are of the greatest value from an aesthetic or scenic standpoint, are gradually being reduced in numbers and that barkbeetles are in a great measure responsible for this process of attrition. On recreational areas and home sites where every large tree has a special value even the normal annual loss of a few trees to the section becomes important. While it is probable that a few old trees will die regardless of the amount of protection attempted, thorough control work should keep the loss at a minimum.

Insect Control

Natural Checks

The natural factors in the control of barkbeetle outbreaks are not adequately understood. Aside from insect and bird enemies, barkbeetles must also contend with the pitch flow of vigorously growing trees which sometimes entirely overcomes an attack by drowning out the attacking beetles. But for these natural checks the barkbeetles would soon be able to kill the entire pine forest. Unfortunately, these checks are usually slow to act and heavy losses often occur before they become effective. Because of this fact, artificial methods must be resorted to where it is expedient to save the mature and over-mature trees as long as possible.

Applied Control

The methods of control which have been developed to combat this type of infestation consist of searching out the trees in which the insects are concentrated and destroying the broods by felling the trees and burning the infested bark or exposing it to the direct rays of the sun.

The best time for doing the work is during the overwintering period from November 1 to May 1 whenever conditions are favorable for the burning method. During this period, practically all of the beetles of the area are concentrated in certain trees - not flying about as many of them are during the summer. Then, too, burning can be carried on at this time with greater safety than during the summer.

However, on the area under consideration where it is desirable to treat every beetle infested tree the work should be put on a year around basis. During the summer months when it is too dry for safe burning the socalled sun curing method should be used. On a warm day, if the bark is peeled and spread out so that the direct rays of the sun strikes it, practically a hundred percent mortality of the broods will result.

Locating the infested trees is one of the most difficult and important parts of the work. Unless a very high percentage of the trees are found, the work will not be a success. Two methods of cruising are used, the strip cruise method of running strips of a given width back and forth across the area until it is entirely covered; and the topographic method of covering the area by taking advantage of natural features, principally ridges. The method to be used in a given case should depend principally upon the topography. The strip method is best suited for even or moderately steep country while the topographic method is best for the more rugged areas.

The infested trees are usually detected by their fading foliage. Shortly after the beetles enter the tree, the foliage turns to a yellowish green then to yellow, sorrel and finally red. This fading may begin at the top and work down or occur over the entire tree at once. Small holes thru the bark and sawdust or pitch tubes in the bark crevices, which are seen on close examination of a suspected tree, are also indicative of insect work.

As these beetles may fly at least two or three miles under certain conditions, the best results can be obtained only by thorough work over all of a definite area which has a reasonable degree of isolation.

Causes of local outbreaks.

It is noticeable that the insect loss often flares up around newly opened tracts where large numbers of trees are felled for road clearing and the construction of cabins. Many of the owners in trying to get rustic effects use green, unpeeled logs, poles, and slabs. This material "loads up" with broods of insects which emerge and often attack standing trees nearby. Any green, felled material also creates an attraction which tends to concentrate all the insects over a considerable area in one spot.

The attracted beetles not only "load up" the felled material but often kill groups of standing poles and trees as well. This applies especially to engraver beetles in yellow pine and jeffrey pine and to a less extent to most of the other important insect species included in this paper. The logs, poles, and slabs of all conifers should be peeled before being used in construction except incense cedar which is fairly free from insect attack and may be used unpeeled for poles and slab work in construction. Green material cut from roads and other clearings if not used may be left unpeeled and used as trap material if it can be watched. As soon as it is attacked, the bark should be peeled and burned.

There will be some objection to this suggestion by people who want to use the unpeeled material because they like its appearance or because they object to the extra cost of peeling.

It will be found in most cases, however, that from the standpoint of either appearance or economy it is best to peel such material. Unpeeled poles and slabs are almost invariably attacked by insects. This often causes the bark to become loosened and fall off and also creates conditions favorable for wood rotting fungi. If the material is peeled and left in its natural state or colored with a dark rustic stain the rustic effect is secured without sacraficing permanence of construction or endangering the nearby trees.

Description and Habits of the More Important Barkbeetles and flatheaded Borers.

Barkbeetles

This group includes the more important tree killing species of insects in the west, Although some species may be found in nearly every tree and many of the shrubs they are of principal importance in coniferous stands.

There are four stages in the development of these insects, (1) the egg stage; (2) the larval or grub stage; (3) the pupal stage, which is a transition stage in which the larva changes to the adult; and, (4) the adult stage.

The adults are hard shelled, usually cylindrical, brown, black, or reddish beetles between 1/16 and 3/8 inch in length. They have well developed wings beneath their hard wing covers and are able to fly a considerable distance.

In attacking a tree, the adult bores thru the bark to the cambium, which is the sap conducting layer between wood and bark. In this cambium the egg galleries or tunnels are excavated. Eggs either singly or in groups, are deposited in niches along the sides of these galleries. When the larvae hatch they either feed and develop on the cambium or bore out into the bark. The broods of the western pine beetle develop in the bark and can be detected, except in the earliest stages, by chopping half way thru the bark.

The broods of the other species of Dendroctonus, the Ips and the Scolytus spp. which we are considering, all develop between the wood and the bark and are easily found by chopping thru the bark.

Flatheaded borers.

The flatheads are not usually considered of much importance as tree killing beetles. In certain situations, however, especially on poorer sites and in jeffrey pine they often prove a menace.

This insect has the same four stages in its development as do the barkbeetles. The adult is also a hard shelled insect but flat rather than cylindrical and considerably larger in size than the barkbeetles. The species to be considered are brown, black or dark blue with a bronze or greenish iridescense. The larvae are white, flattened grubs with large heads.

Their eggs are laid just beneath the outer bark scales and in bark crevices by the attacking adult. When the grubs hatch they work down into the cambium and mine and feed upon the cambium making irregular flattened tunnels, well packed with sawdust, which gradually increase in size as the larva grows. When the larva is full grown it bores its way out into the bark where it pupates, and then emerges as a new adult.

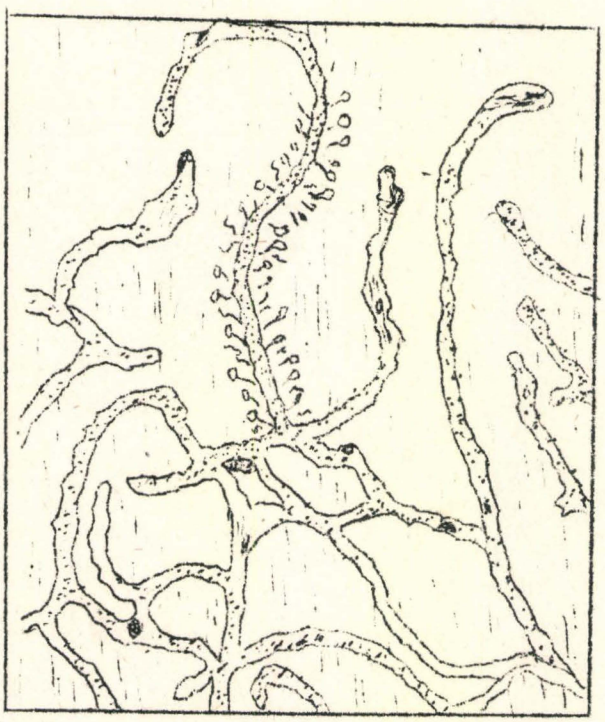
(See last page for chart giving the principle insects and what they attack.)

THE WESTERN PINE BEETLE

(Dendroctonus brevicomis Lec.)

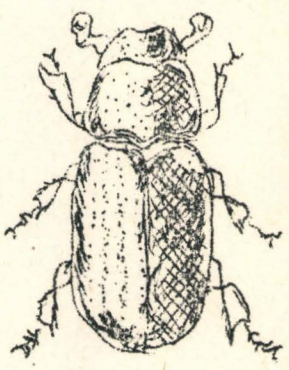
This species undoubtedly kills more timber than any other forest insect in California. It attacks only western yellow pine and coulter pine. It apparently prefers the slower growing less vigorous trees but often kills the healthiest trees as well. Any tree from 8 inches to the largest diameter is subject to attack. Besides killing the standing green trees it breeds to some extent in windfalls, larger pieces of logging slash and the trunks of trees felled for right of ways and other clearings. It rarely breeds in limbs or other parts of trees less than 8 inches in diameter.

The adult is a small, dark brown to black, cylindrical beetle slightly over 1/8 inch in length. The larvae are small, white legless grubs less than $\frac{1}{4}$ inch in length, with light brown heads.



Design of egg galleries on inner bark.

I



Adult beetle greatly enlarged.

In attacking a tree the adult beetles bore thru the bark to the cambium or sap conducting tissue between bark and wood. They mine the cambium in constructing their narrow winding egg galleries, and effectually girdle the tree.

The grubs upon hatching gnaw their way out into the inner bark where they develop change to the adult beetle form (pupate) and emerge thru the bark to fly and attack another tree.

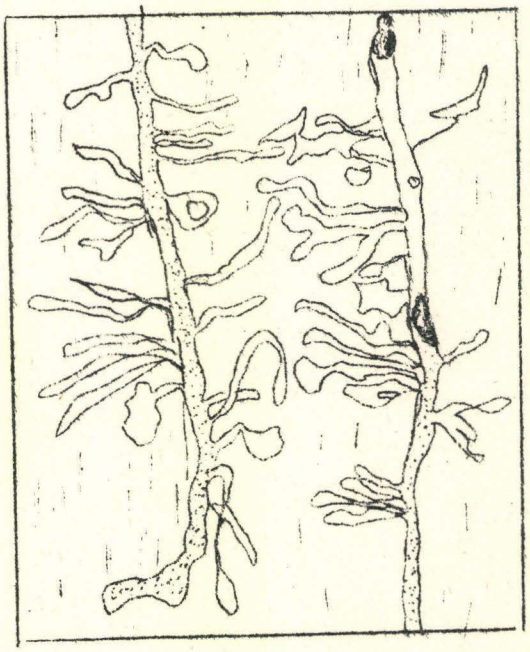
There are about three generations of this beetle a year, more or less, depending upon the locality and the season.

The most effective method of control consists of peeling and then burning the infested bark. Where it is dangerous or impracticable to burn, the broods can be destroyed during the summer season by peeling the infested bark and exposing it directly to the sun's rays.

The Mountain Pine Beetle
(Dendroctonus Monticolae Hopk.)

The mountain pine beetle is also a very important tree killing species. Its principal host in Southern California is sugar pine but it will also attack western yellow pine, especially the small trees, lodgepole pine, western white pine and rarely coulter pine. It breeds in both standing green trees and felled trees. Material under 8" in diameter, while occasionally attacked, will rarely produce a brood.

The audult strongly resembles the western pine beetle in appearance. It is larger, however, being about $\frac{1}{4}$ inch in length and is black, rather than brownish black. The larvae also have the same appearance as the Dendroctonus brevicomis larvae though they are slightly larger.



Design of egg galleries on inner bark.

The adults attack by boring thru the bark to the cambium. Here the egg galleries are excavated and the eggs are laid usually in groups of three in niches along the sides of the galleries.

In this species, the egg galleries are vertical and fairly straight usually following closely the grain of the wood. The larvae, upon hatching work out at right angles to the egg galleries, developing and changing to the adult form in the inner bark. When mature, the adults bore out thru the bark and fly in search of another favorable breeding place.

There are from one to two generations a year.

The best known method of control is the same as that used against the western pine beetle. The trees are felled and the bark peeled and either burned along the trunk of the felled tree or exposed to the direct rays of the sun. When most of the brood is in the larval stage it may be effectively treated simply by peeling the bark without the use of fire or solar heat.

The Jeffrey Pine Beetle
(Dendroctonus jeffreyi Hopk.)

This species is only of minor importance never causing heavy losses so far as is known. Its principal host is jeffrey pine, in which it is often found associated with one of the flatheaded borers. It attacks principally standing trees, seldom being found in down material.

It closely resembles the mountain pine beetle both in the appearance of the different stages of the insect and in its work.

The adults and full grown larvae are slightly larger than the same forms of the mountain pine beetle. The vertical egg galleries with the larval mines going out at right angles between the bark and the wood are typical of both species.

The method of control used for the mountain pine beetle will be equally affective against the jeffrey beetle.

The Turpentine Beetle.
(Dendroctonus valens Lec.)

This beetle occasionally kills trees especially in stands of Monterey Pine in which some serious losses have occured in local areas. In some places it causes appreciable damage by killing patches of bark and leaving ugly scars around the bases of particularly valuable trees.

It attacks any of the pines, principally at the base or up the trunk to a height of about 12 feet. It also breeds in stumps and the larger pieces of freshly cut material.

The insect itself resembles the jeffrey pine beetle in all its stages, except for color differences. The adults are reddish brown, instead of black and the larvae are yellowish white rather than white.

The work of the turpentine beetle is quite distinctive. The parent adults bore through the bark to the cambium and there excavate broad, somewhat irregular, winding, vertical egg galleries. The eggs are placed in groups or masses at intervals along the sides of the galleries. The larvae do not make separate tunnels, but all feed together eating out cavities in the inner bark from a few inches to several feet square. They transform to pupae and adults in separate or closely joined cells in the inner bark.

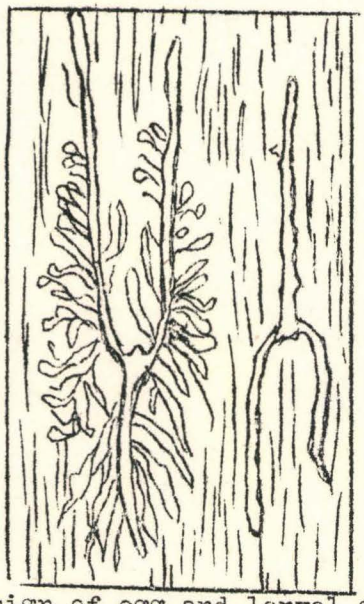
If the damage from this insect becomes serious, it may be controlled by digging out and killing the attacking adults. They are easily located by the large reddish brown pitch masses or tubes which this insect makes in taking care of the pitch flow of the attacked tree. If the brood has already started to develop it may be destroyed by a generous application of kerosene. It is well to treat the wound in the tree by painting with creosote or coal tar.

The Engraver Beetles
(Ips spp.)

The insects of this group are called engraver beetles because of the fact that their galleries or tunnels groove the wood, leaving permanent markings that look like engravings. Each insect has a characteristic signature by which its work can be identified.

Altho there are a large number of different species in this group, Ips confusus and Ips oregoni are the only species of particular importance in the areas being considered. Ips confusus is found principally in the yellow and coulter pines and Ips oregoni in the jeffrey pine. They are very similar in appearance and habits and, for the purposes of this paper, may be treated as one insect.

They attack all of the pines but do most of their damage to yellow pine, jeffrey pine, and coulter pine, killing reproduction and young trees up to 18 inches in diameter and topkilling trees of any size. They are the most important of the slash insects, finding favorable breeding conditions in any felled unpeeled, green material over 2 inches in diameter. They are attracted from long distances to an area by freshly cut pine material. Usually, the attracted beetles load up not only the cut material but some of the standing trees nearby. These insects are responsible for most of the topkilling seen in the pines and frequently for the group killing of 10 to 100 trees in young stands.



Design of egg and larval galleries on inner bark.

Adult beetle greatly enlarged.

The adults are small, brown, shiny cylindrical beetles easily recognized by their peculiar rear end which appears as though a piece had been cut out of the top side forming a little cavity. Upon close examination a row of small tooth like projections may be seen on each side of this cavity.

The larvae are small, white, legless, cylindrical grubs; in appearance much like the western pine beetle larvae though slightly smaller.

The parent adults bore thru the back to the cambium and excavate their straight, vertical egg galleries between the inner bark and wood, grooving both. The eggs are laid singly in niches along the egg galleries and the larvae work out at different angles so as to cover a fan shaped area on each side of the egg gallery. The egg galleries are left open, not filled with borings as are those of the western pine beetle.

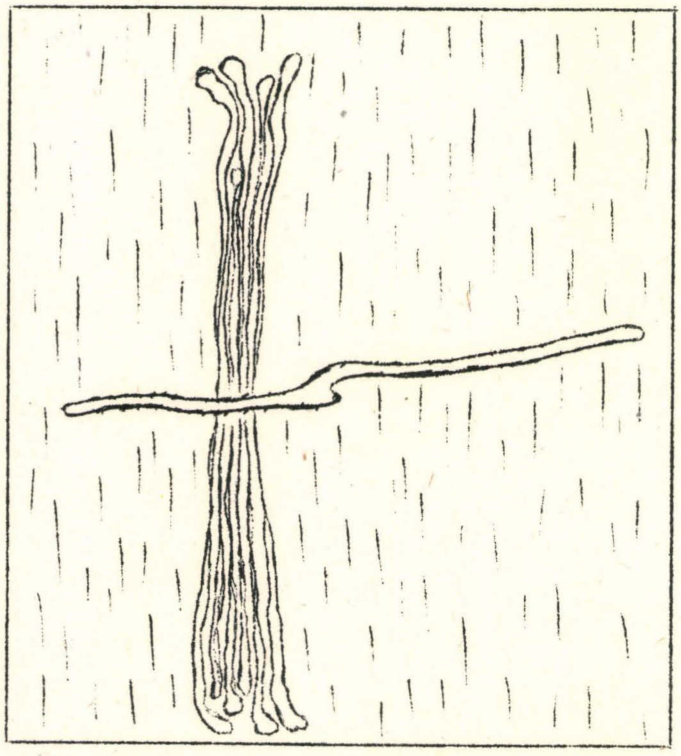
The control methods used against the engraver beetles are about the same as those used against any of the bark beetles. In many cases of group outbreaks in small trees the easiest method is to fell the trees in piles and burn them without peeling.

The Fir Bark Beetle.
(Scolytus spp.)

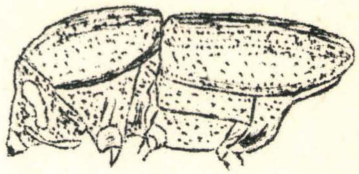
The principle Scolytus in southern California is probably Scolytus subscaber Lec. In that section it attacks only white fir. Its work is not ordinarily serious but during periods unfavorable for the trees, such as the recent drought period, it increases in numbers until it is able to kill small trees either singly or in groups and also topkill and occasionally kill outright large trees. This beetle also breeds commonly in green, felled material.

The adults are small, shiny black, subcylindrical beetles about 1/8 inch in length. The upper third of the body and the wing covers extend out beyond the rest of the beetle, at the rear end, giving it a characteristic appearance typical of the insects of this group.

The larvae are small, white, legless, cylindrical grubs much like the larvae of the engraver beetles.



Egg galleries on the wood showing only a few of the larval galleries.



Adult (side view) greatly enlarged.

The adults attack by boring thru the bark and excavating their rather short, straight, horizontal egg galleries in the cambium. As this is the only insect, being considered, which makes horizontal egg galleries its work can be easily distinguished from that of the others. The eggs are laid singly in niches along both sides of the main galleries and the larvae upon hatching work vertically up or down the tree between the wood and bark, engraving the wood as do the engraver beetles. When mature, the grubs pupate and emerge thru the bark, ready to fly and attack another tree.

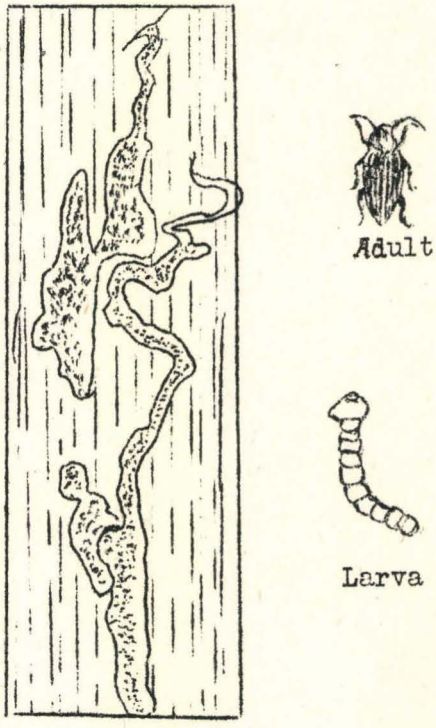
The control methods used against this insect are identical with those used against the engraver beetles.

The Flatheaded Borers

(Melanophila spp.)

The species of principal importance in Southern California is Melanophila californica Van Dyke although Melanophila gentilis Lec. probably occurs to some extent in this section also. These species attack any of the pines but rarely kill trees except in jeffrey pine stands. Even in jeffrey pine most of the damage occurs among the slow growing, weakened trees on the more exposed locations. The loss from these insects is not ordinarily heavy but during periods which are unfavorable to tree growth such as the recent drought period, this loss may become serious.

These beetles breed commonly in down material and fire killed or injured trees as well as the living trees.



Design of larval galleries on inner bark.

The adults have the hard covering typical of all the beetles. They are considerably larger than the bark beetles, averaging just under ½ inch in length and about ¼ inch in width, and are flat rather than cylindrical. In color they are dark brown, black or blue with greenish iridescence. The larvae are white legless grubs, distinctly flattened, with the head segment greatly enlarged. They are about 3/4 inch in length when full grown.

The eggs are laid beneath the outer bark scales and in the bark crevices. When the larvae hatch they work their way into the cambium where they mine their winding tunnels. These tunnels, or larval galleries, increase in size as the larva grows and are closely packed with the sawdust like borings. When the larvae are full grown they bore out into the bark where they change to the adult form and then emerge.

Control work against these beetles consists of felling the infested trees and destroying the bark as is done in the control of the western pine barkbeetle.

THE MORE IMPORTANT TREE KILLING INSECTS AND THEIR HOSTS